

BIRDS OF A POLLUTED RIVER¹

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(With four text-figures & three maps)

The Mutha river meanders through Pune City for a distance of over 6.5 km from Vitthalwadi to the Southwest, to the Sangam in the northeast, before it merges into the Mula at the latter place. The joint stream then flows for a distance of 4 kilometres before it leaves the city-limits.

I have been watching birds along these stretches of the rivers for well over fifteen years, i.e. since the mid-sixties. This article however, while taking note of some of the major changes noted over all these years, is primarily based on systematic observations made over a period of over six months, i.e. from October 1982 to April 1983.

Special mention should be made of the tail-end portion of the Mula-Mutha, where the joint stream leaves the city-limits. This 1.5 km stretch of the Mula-Mutha now constitutes the Mula-Mutha Bird Sanctuary inaugurated by Dr. Sálím Ali in 1977. The Sanctuary deserves separate treatment on account of the numbers and variety of birds found there in winter and spring.

QUALITY OF RIVER-WATERS

It is generally believed that the water of both the rivers is polluted. Sewage overflows into the rivers at many points and industrial effluents

also drain into the rivers. To gauge the extent of pollution, water-samples were collected at many points along the river-course. For chemical analysis of water a five-litre sample was collected from each of the points and 250 cc samples were used for the MPN count. Tables 1A and 1B show results of the analysis of water-samples. The names of collection points are also given in the tables and the same can be seen on maps. To compare the quality of water of the rivers with that of other water-bodies, samples were also collected from the Khadakwasla reservoir upstream on the river Mutha and from Ambil Odha, a stream that meets the Mutha in the city.

It will be seen from Table 1A that as the river flows from Vitthalwadi to the Sangam the proportion of solids, Dissolved solids, COD, BOD and Chlorides goes on increasing which indicates that the river is receiving higher and higher loads of organic matter. This is due to the increase in the number of sewage overflows going into the river. The oxygen content is mostly low. The water of Ambil Odha which flows through densely populated areas and on whose banks a number of hutment colonies are located, brings into the river even greater loads of pollution. It is also worth noting that samples from the Mula and the Mula-Mutha also show a higher concentration of pollution and compare favourably with the Odha.

Table No. 1B shows the results of the MPN count. Predictably the analysis shows an in-

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TABLE 1A

CHEMICAL AND BACTERIOLOGICAL ANALYSIS OF WATER SAMPLES COLLECTED AT DIFFERENT POINTS ALONG THE RIVERS IN PUNE CITY

Count of	No. of Collecting Stations along the Mutha, the Mula & the Mula-Mutha										Names of Stations
	1	2	3	4	5	6	7	8	9	10	
Turbidity (ppm)	07	16	06	12	11	09	14	11	08	15	1 = Khadakwasla Reservoir
Total Solids (mg/litre)	108	120	100	168	184	200	252	322	190	334	2 = Upstream of Vitthalwadi
Dissolved Solids (mg/l)	108	108	100	148	167	191	246	218	180	292	3 = Opp. Pumping Station
C O D	10	04	24	25	21	05	78	70	19	150	4 = Upstream of Garware Causeway
B O D	03	01	07	07	06	02	30	22	07	40	5 = Near Shinde Bridge
Dissolved Oxygen	4.20	1.40	4.60	4.20	5.20	4.30	2.90	2.40	1.30	3.0	6 = Upstream Dengele Bridge
Nitrates (N205)	—	—	—	—	—	—	—	—	—	2	7 = Downstream Holkar Br. (on the Mula)
Nitrites (N203)	—	—	—	—	—	—	—	—	—	—	8 = Downstream Sangam Br. (on the Mula-Mutha)
Chlorides (Cl)	14	8	21	21	21	28	35	42	49.5	35	9 = In Bird Sanctuary 10 = In Ambil Odha

TABLE 1B

BACTERIOLOGICAL COUNT OF WATER COLLECTED AT DIFFERENT POINTS ALONG THE RIVERS IN PUNE CITY

M P N Results: Count per 100 ml of water		
Sample Collected at	Date	Count
1. Upstream of V. wadi	22.3.83	1.4×10^6
2. Opp. Pumping Station	25.3.83	2.0×10^5
3. Below Garware Causeway	22.3.83	2.5×10^6
4. Near Natraj Causeway	22.3.83	1.3×10^7
5. Below Omkareshwar Temple	22.3.83	1.3×10^7
6. Below Shivaji Bridge	22.3.83	3.5×10^6
7. Below the Sangam	6.4.83	1.5×10^5
8. In the Mula River	6.4.83	1.0×10^5
9. In Bird Sanctuary	24.3.83	3.5×10^7

creasing concentration of organisms per 100 ml as the river flows from Vitthalwadi to Sangam Bridge. The conspicuous rise in coliform MPN indicates faecal pollution. This makes the water highly dangerous to human beings and activities such as bathing, washing clothes and utensils, which are normally carried out by citizens on the river, are fraught with danger of infection. However, as will be seen from the discussion that follows, this water, which carries a great load of organic matter, may not necessarily be dangerous to birds. Indeed it appears that certain species of birds thrive on it.

BROAD HABITAT-TYPES ALONG THE
RIVER COURSE

The 6.5 km stretch of the Mutha and the further 4 km stretch of the Mula-Mutha exhibit a variety of habitats. They are : 1) Deep water; 2) Shallow water; 3) Marshy land; 4) Grassland; 5) Rocks and boulders, and 6) Dryland and scrub. Riverside trees also constitute a distinct habitat, though arboreal birds are not considered here. Let us now see the characteristic bird-life of each of these habitats. The broad extent of each of these habitats is shown in the maps.

DEEP-WATER HABITAT

The Mutha river within Pune city is shallow with an average depth of less than a metre. In certain places, however, deepish pools are formed, e.g. near Vitthalwadi, near Omkareshwar Temple, and near the Sangam. The Mula is a bigger river and the stretch between Holkar Bridge and Sangam is deeper (average depth about 2 metres). The joint flow below Sangam is of considerable depth too, due to impoundment near Bund Garden. The river-flow is again shallow in the Bird Sanctuary.

The common submerged plants occurring in this habitat are : *Hydrilla verticillata*, *Lemna gibba*, *Ceratophyllum demersum*, *Vallisneria spiralis*, *Spirodela polyrhiza* etc. *Eichhornia crassipes* became progressively dominant after October, especially in the Mula and by March it had almost covered the open water in the Bird Sanctuary. Another obnoxious weed *Pistia stratiotes* was also recorded at a few places especially on the Mula.

The characteristic bird of this habitat appears to be Little Grebe or Dabchik. Groups of these birds were seen at every place on the Mutha where there is deepish water.

The stretch of the Mula considered here does not hold any Dabchik perhaps due to lack of aquatic food and movement of boats in the river. Upstream of Garware causeway these birds were seen to breed from February onwards on little platforms made up of aquatic plants (*Hydrilla*) and floating debris. Three nests and a pair with two chicks were seen in the last week of February 1983.

Coots, Little Cormorants, a few Large Cormorants and ducks like Garganey Teals, Pintails and Shovellers were the other birds that belonged to this habitat. The Cormorants are a recent addition to the river fauna. The Little Cormorants started appearing on the river since 1969 and the Large ones came as recently as 1980. They perhaps reflect the abundance of small and medium-size fish in the river; fish that thrive on the nutrient-rich sewage water. It may be significant that the Cormorants were absent when the proportion of sewage in river-water was low, i.e. before the seventies. Do these fish-eaters indicate the quality of fish in the waterbody, in this case smaller fish? For, all the fishermen whom we asked about the quality of fish in the river, complained that good quality fish are no longer found in the river, except during a few days immediately after the monsoon. This aspect of the correlation between Cormorants and fish needs deeper investigation, however.

Ducks were concentrated in deepish pools in the Bird Sanctuary. Garganey Teals became numerous after 1972. They use the Sanctuary area during daytime for resting on rocks mid-stream and appear to feed on chironomus larvae and other floating insects. Over 800 were counted in early March 1983. Since 1970 an occasional Pintail used to be seen in the Sanctuary area. In the winter of 1982-83 their number was the highest recorded so far.

A few Shovellers with the colourful males outnumbering females are to be seen in the Sanctuary every winter. They feed on floating aquatic insects.

SHALLOW-WATER HABITAT

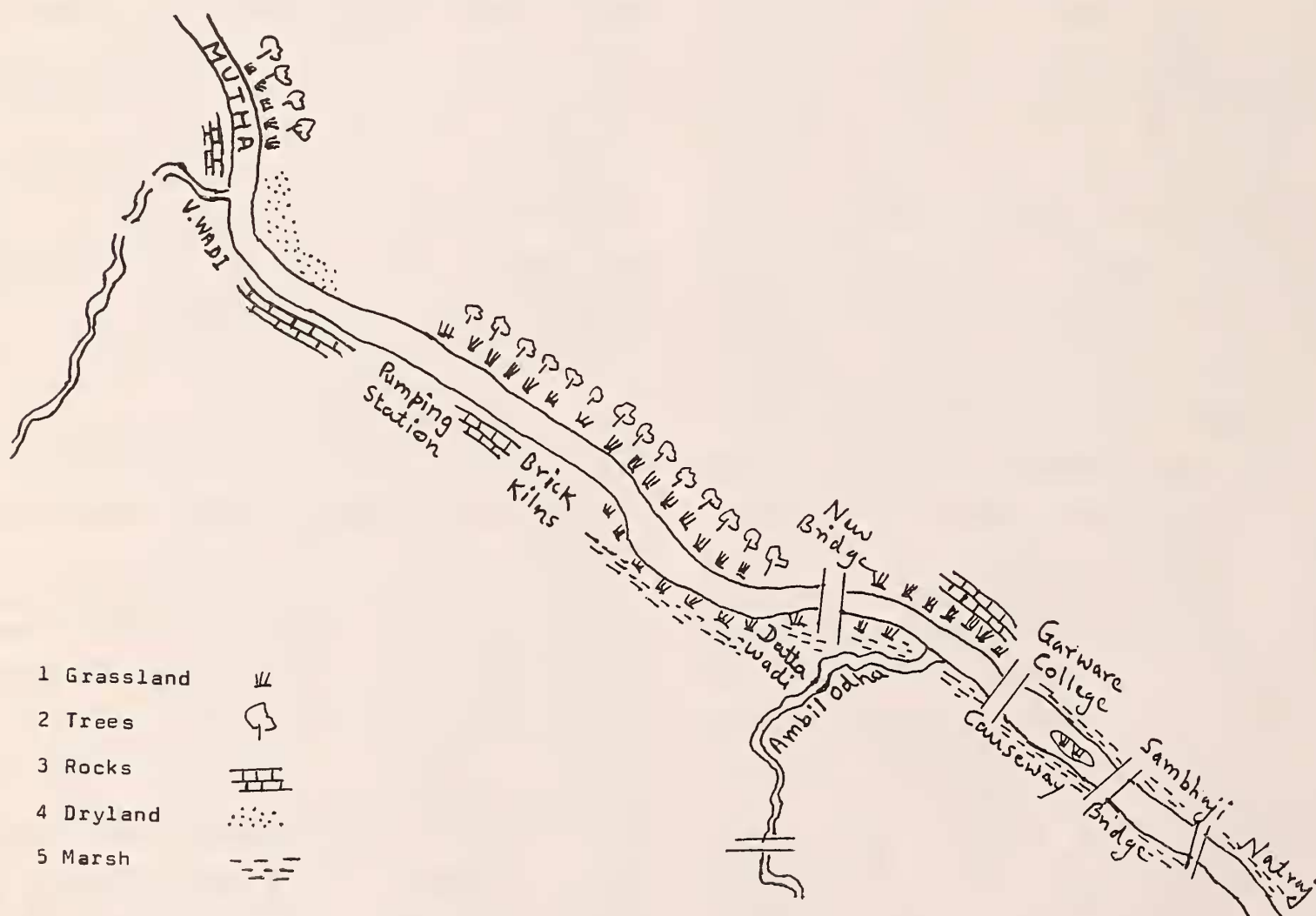
Most of the stretch of the Mutha river considered here, being shallow, this habitat covers probably the greater part of the river ecosystem. The water is shallow, at places even midstream, and there are rocky outcrops, islands, floating vegetation and other debris which the birds can take advantage of, while wading through shallow water.

Plants of this habitat include partly submerged plants, plants growing at the edge of

water and those growing along drains and other effluents flowing into the river. *Cryptocoryne retrospirallis*, *Xanthium strumarium*, *Ammania baccifera*, *Commelina* sp., *Cyperus pangorei*, *Polygonum glabrum*, *Asclepias curassavica*, *Hygrophila auriculata* etc. were seen to be common here.

Typha angustata, *Jussiaea suffruticosa*, *Crinum defixum*, *Bacopa monnieri*, *Phyllanthus niruri*, *Ricinus communis* and *Ipomoea palmata* were the common plants seen growing around sewage overflows and effluents.

The most characteristic birds of this habitat are the long-legged herons and stilts. The numbers of egrets and Black-winged stilts have risen considerably in recent years on the rivers. Intermediate and Little



Map. 1. Habitats along the Mutha.

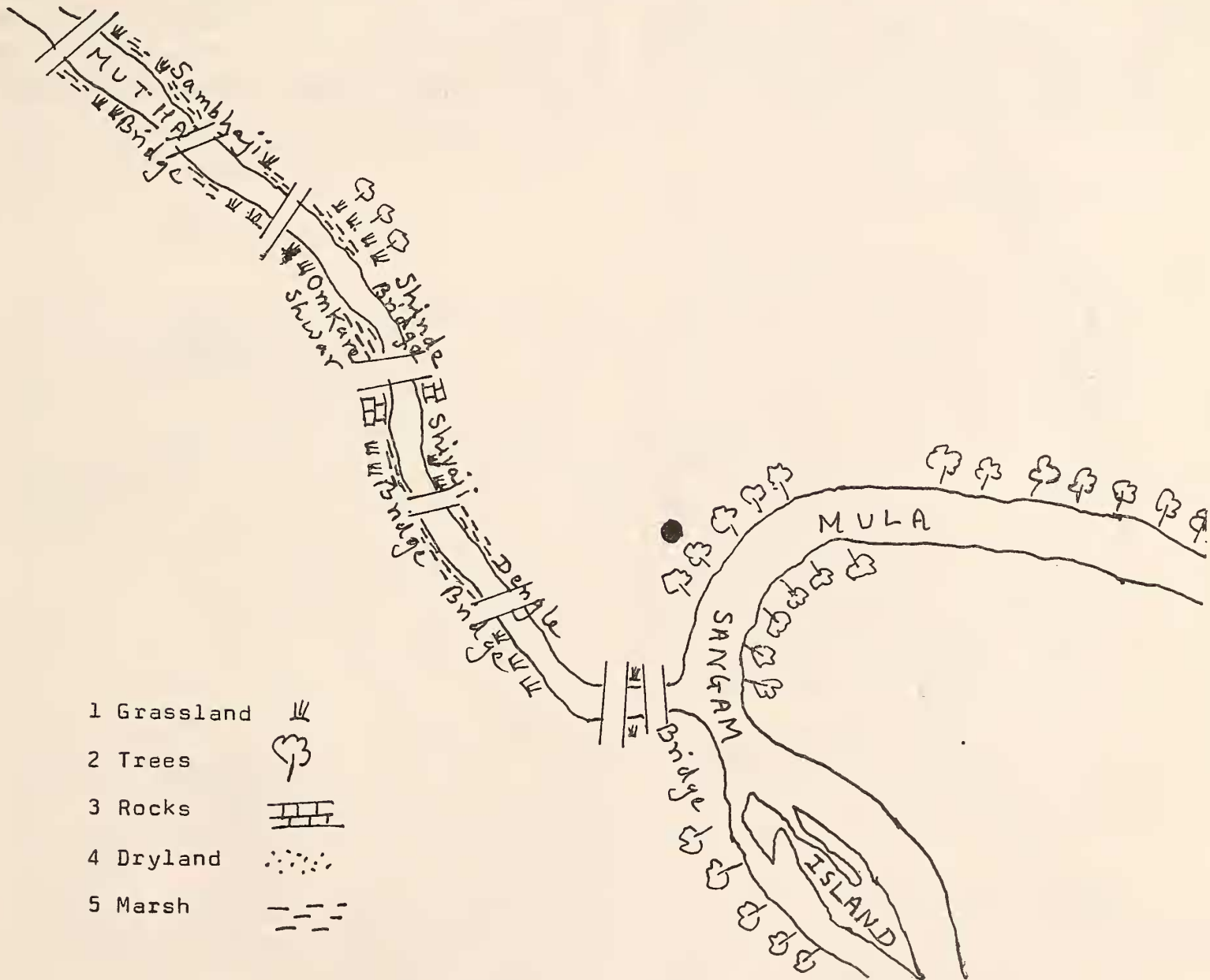
BIRDS OF A POLLUTED RIVER

egrets are more common than the cattle egrets which were mostly seen around sewage overflows and accompanying cattle. The egrets perch on rocks, islands and floating debris including the weed *Eichhornia* and were also seen to congregate around streams that pour a tremendous load of faecal contamination into the rivers.

Pond herons are more solitary than egrets. They feed at the edges of water and in dense masses of *Eichhornia*. By the beginning of April some cattle and little egrets came into breeding plumage. Large egrets, Grey and

Purple herons, and occasionally an open-billed stork and a White ibis were noted in this habitat, especially on the quieter stretches of the Mutha, i.e. between Dattawadi and the Pumping Station and in Bird Sanctuary. While the larger herons appeared to feed mainly on fish, egrets and pond herons were seen to catch insects from the vegetation at the edge and on islands. All the herons are only fair weather inhabitants of the rivers and disappear completely in June and July and reappear by August-end.

Blackwinged stilts are also a comparatively



Map. 2. Habitats along the Mutha and the Mula.

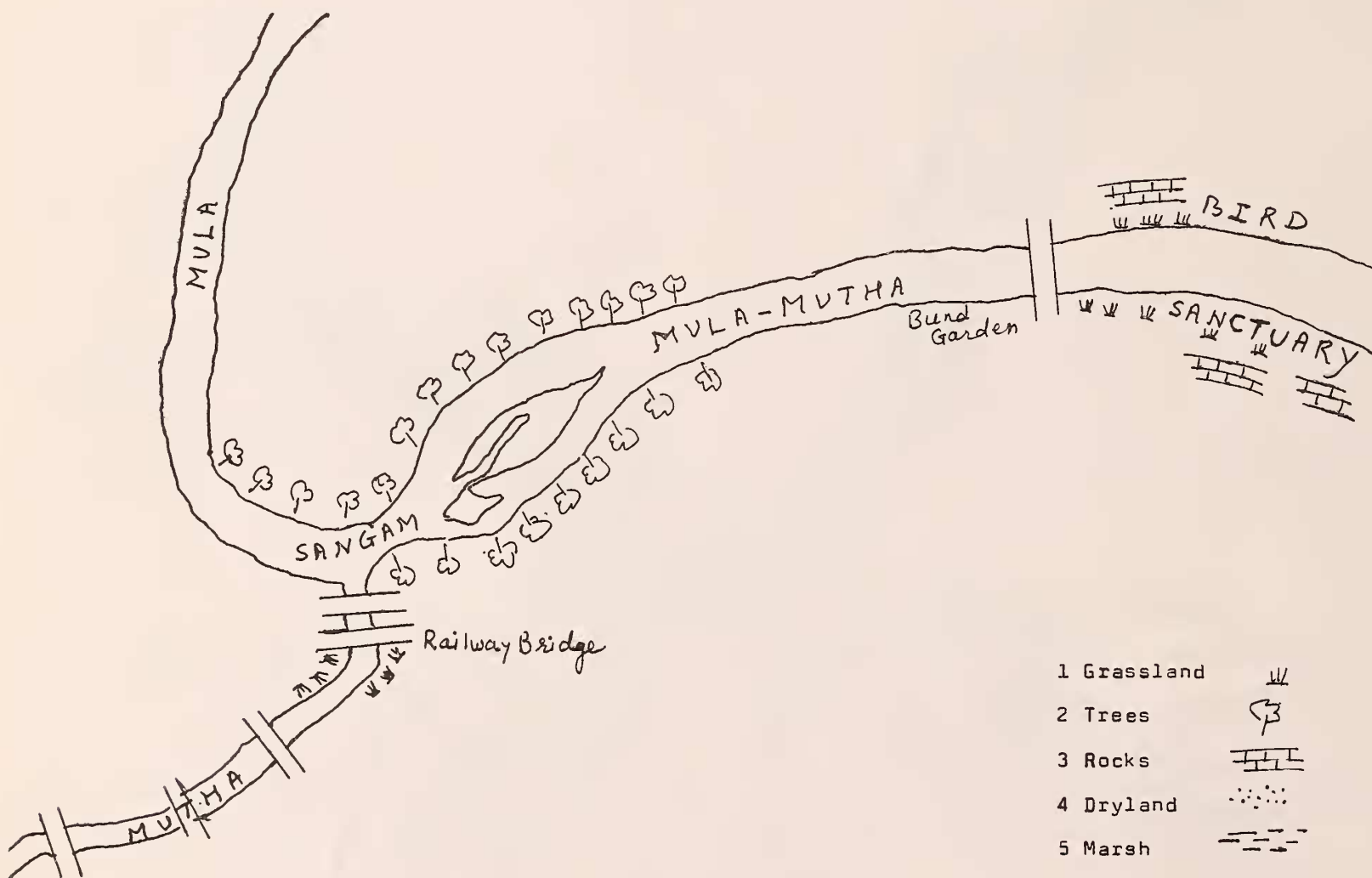
recent addition to the river fauna. They were detected in some numbers in 1968-69 and since then their number has been increasing year by year. Their flocks are to be invariably met with near sewage outflows and in and around streams that pour sewage in the river. They arrive by the end of September every year and their peak numbers are reached in January. In January 1983 over 2000 could be seen on the rivers.

Three species of Sandpiper, viz. Common, Green and Spotted, Little stint, Greenshank, Ruff and reeve, Little Ringed Plover etc. are the other birds seen in this habitat. They are numerous where grassy edges and rock slabs touch the waters. Actually their habitat is, of late, decreasing all along the rivers as open

water near the edges is being covered by *Eichhornia* especially in the Bird Sanctuary. Egrets, pond herons, wagtails and to a lesser extent sandpipers feed on mosquitoes, spiders and beetles hiding in its leaves. Yellow and White wagtails and to a lesser extent Large Pied Wagtail are thus found not only on the patches of turf and rock along the rivers but also on the floating water hyacinth.

MARSHY HABITAT

Water-logged areas are thinly spread along the rivers, especially where bays and inlets are formed and where there are depressions between rock slabs. Plants of this habitat are not much different from the previous one. *Ipomoea* species such as *I. carnea*, *I. nil*, *I.*



Map. 3. Habitats along the Mula-Mutha.

BIRDS OF A POLLUTED RIVER

muricata were recorded commonly in marshy areas. Also *Marselia*, *Rorippa indica*, *Homonnia riparia* were recorded from marshy places.

The characteristic bird of this habitat was seen to be Snipe (Fantail or Pintail?) and to some extent Painted Snipes were usually found hidden in the short, wet grass. Where the grass is taller and typha stands abound, hide Purple and Indian moorhens. Bronze-winged and Pheasant-tailed Jacanas used to be found on the river some years ago. The former has now completely vanished while the latter is seen in decreasing numbers year by year. Though these birds can take advantage of floating vegetation due to their long toes, they are not seen to be much associated with *Eichhornia*. Indeed there is some reason to believe that since the advent of this noxious weed, these species have declined in number.

GRASSLAND HABITAT

Wagtails usually exploit grasslands both dry and wet. Three subspecies of Yellow Wagtail are usually found along the river. In late winter the Yellowheaded wagtail adds to their numbers. There used to be enormous flocks of yellow wagtails on the dry, scrub-covered plateau and grassland on the left bank of the Mula-Mutha in the Bird Sanctuary. But as this plateau is now planted up with trees, there is a noticeable decline in the number of wagtails here. The resident Indian species of wagtail, the Large Pied, is found in pairs all along the river. They are fond of perching on rocks mid-stream and were seen to run on grass or to hunt for insects on floating *Eichhornia*.

Cyperus pangorei, *C. globosus*, *Fimbristylis bisumbellata*, *Eleocharis capitata*, *Echinochloa colona*, *Cynodon dactylon*, *Chloris barbata* are some of the typical plants of this habitat.

ROCKY HABITAT

Rocks are exposed in several places along the Mutha. At Vitthalwadi there is a broad platform of basalt on the right bank. There is also a broad and high rocky platform on the left of the Mula-Mutha in the Bird Sanctuary. In between there are rock exposures on both the banks of the Mutha and rocky outcrops in the shallow river-bed. The deeper Mula does not show rocky exposures on either its banks within city limits or mid-stream.

Plants growing in rock crevices and between gaps in rocks were found to be mostly grasses. *Cynodon dactylon*, *Cyperus pangorei*, *Alternanthera sessilis*, *Commelina* sp. were some of the plants recorded from this habitat. On wet rocks near puddles red patches of *Rotella tenuis* were observed and in rock crevices and on wet rocks *Canscora diffusa* was also seen.

Redwattled Lapwing was perhaps the most characteristic denizen of this habitat. Two species of Kingfisher, viz. Small Blue and Whitebreasted can be seen perched on rocks at many places. As fish and frogs are to be found in practically every part of the rivers these kingfishers are to be seen everywhere except the stretch between Sambhaji Bridge and Sangam Bridge. At Vitthalwadi and in the Bird Sanctuary there are puddles and pools formed in depressions in rocks. Redwattled Lapwing, Green Sandpiper and the two kingfishers can usually be seen on these pools. Grey Shrike, Rufousbacked Shrike and Little Brown Doves and Indian Robin are some of the other birds found here.

DRYLAND HABITAT

Patches of dry, stony ground dotted with bushes of *Lantana*, *Calotropis*, *Pongamia* etc. can also be found along the Mutha river. On

one such plateau in the Bird Sanctuary, trees such as *Erythrina* sp., *Bauhinia* sp., *Cassia* sp., *Bombax ceiba*, *Cochlospermum religiosum*, etc. are now planted.

Small bushes and stunted trees provide convenient perches for a number of bird species. Rufousbacked Shrike, Common Green Bee-eater, Stonechat, Black Drongo, Large Grey Babblers are normally seen to take advantage of these. Crows and Common Mynas are attracted to these dry, dusty patches on account of the movement of men and their cattle. The Common Myna has some favourite roosting trees along the river. Before flying into these trees at dusk the Mynas use these dry slopes as gathering stops where they assemble in enormous numbers moving into the roosting trees before sunset.

COMMUTING BIRDS AND BIRDS SEEN IN FLIGHT

The broad river channel of the Mutha appears to provide a route to commuting birds. In the morning Little Cormorants, Little and Cattle and Intermediate Egrets, Common Mynas and to a lesser extent Roseringed parakeets appear to follow the river on their foraging trips. They take the reverse route in the evening. Pied Kingfishers are fond of travelling a great deal along the river course. They favour the deepish pools, perching on wires running across the river or scanning the water surface by hovering in the air. They probably require a transparent surface and consequently were seen to be common at places where the turbidity index was low. In their beats up and down the river they rarely stop to hover between Sambhaji Bridge and Sangam. Gullbilled terns and Marsh Harriers patrol the river to and fro. The terns pick up insects and floating debris from the surface while the Harrier looks for larger prey. House Swifts, Eastern

Common and Redrumped Swallows and sometimes Little Pratincoles are seen to hawk insects in the air.

Trees lining the banks between Vitthalwadi and Dattawadi Bridge and again in the Bird Sanctuary area are seen to be patronised by such arboreal birds as Grey Hornbill, Golden Oriole, Koel, Crimsonbreasted Barbet, Iora, Grey Tit, Crow-Pheasant, Small Minivet etc. Even the call of the Grey Partridge could be heard from cultivation opposite the Pumping Station and near the Bird Sanctuary.

THE WINTER OF 1982-83

Between October 1982 and April 1983 systematic observation and counts of birds were carried out on the river Mutha and in the Bird Sanctuary on the Mula-Mutha. Birds were counted once every month while certain species were singled out for more intensive counts and observations. During this period 71 species of birds were recorded on the rivers. Their distribution according to habitat was:

- Deep-water Habitat: 6
- Shallow-water Habitat: 9
- Marshland Habitat: 16
- Dryland and Rocky Habitats: 24
- Riverside Trees: 5
- Birds in flight: 11

On any one day an average of 37 species were noted on the river Mutha during this period, with a total number of 1806 individuals. In this stretch of about 6.5 km this number gives an average density of 277 birds per kilometre. This number does not include arboreal birds seen on trees by the riverside. In the Bird Sanctuary on an average 1490 individuals belonging to 42 species were recorded on the days of counts. This 1.5 km stretch thus gives a density of 993 birds per kilometre.

As will be seen from Fig. 1 there are some

BIRDS OF A POLLUTED RIVER

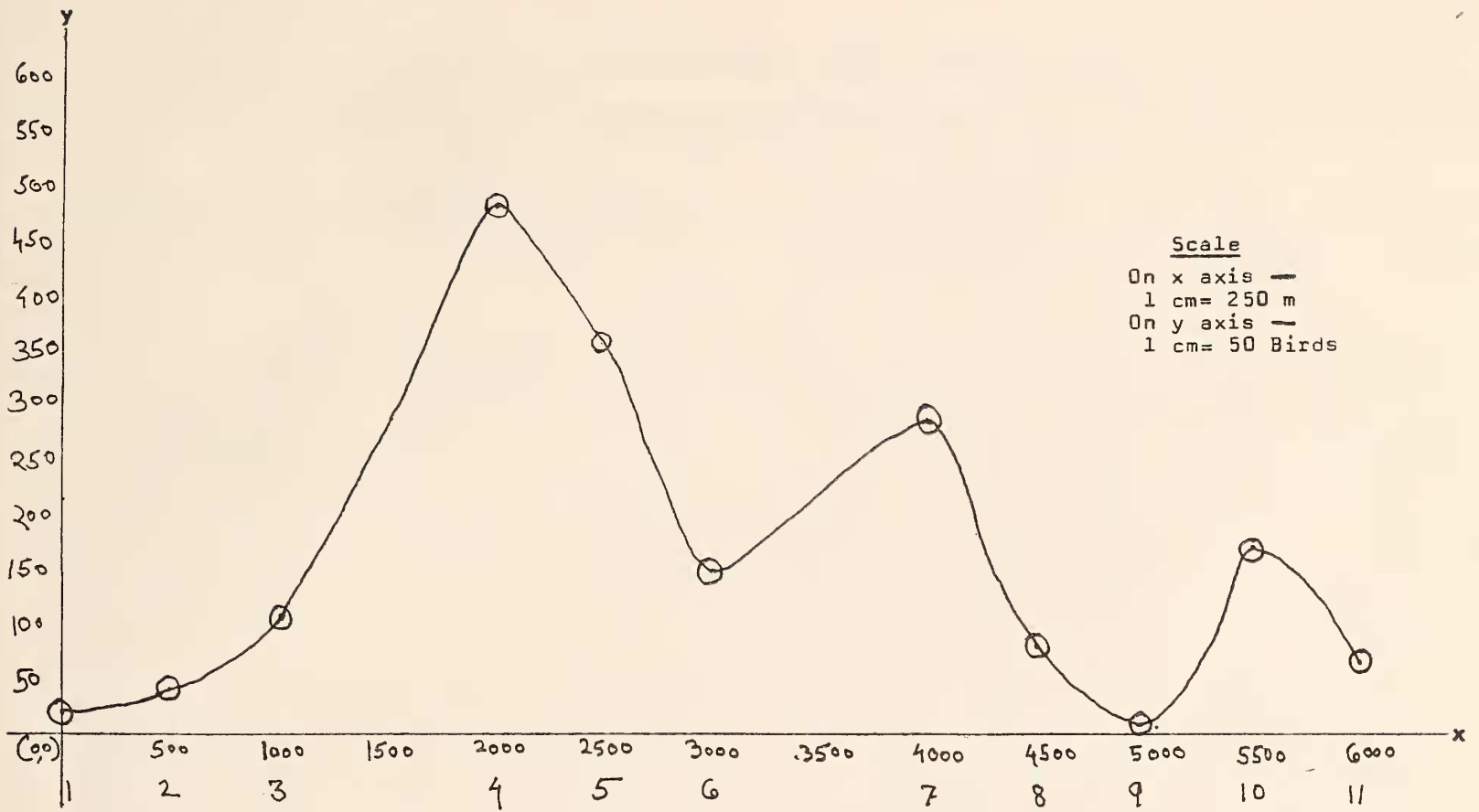


Fig. 1. Distribution of Birds along the river.

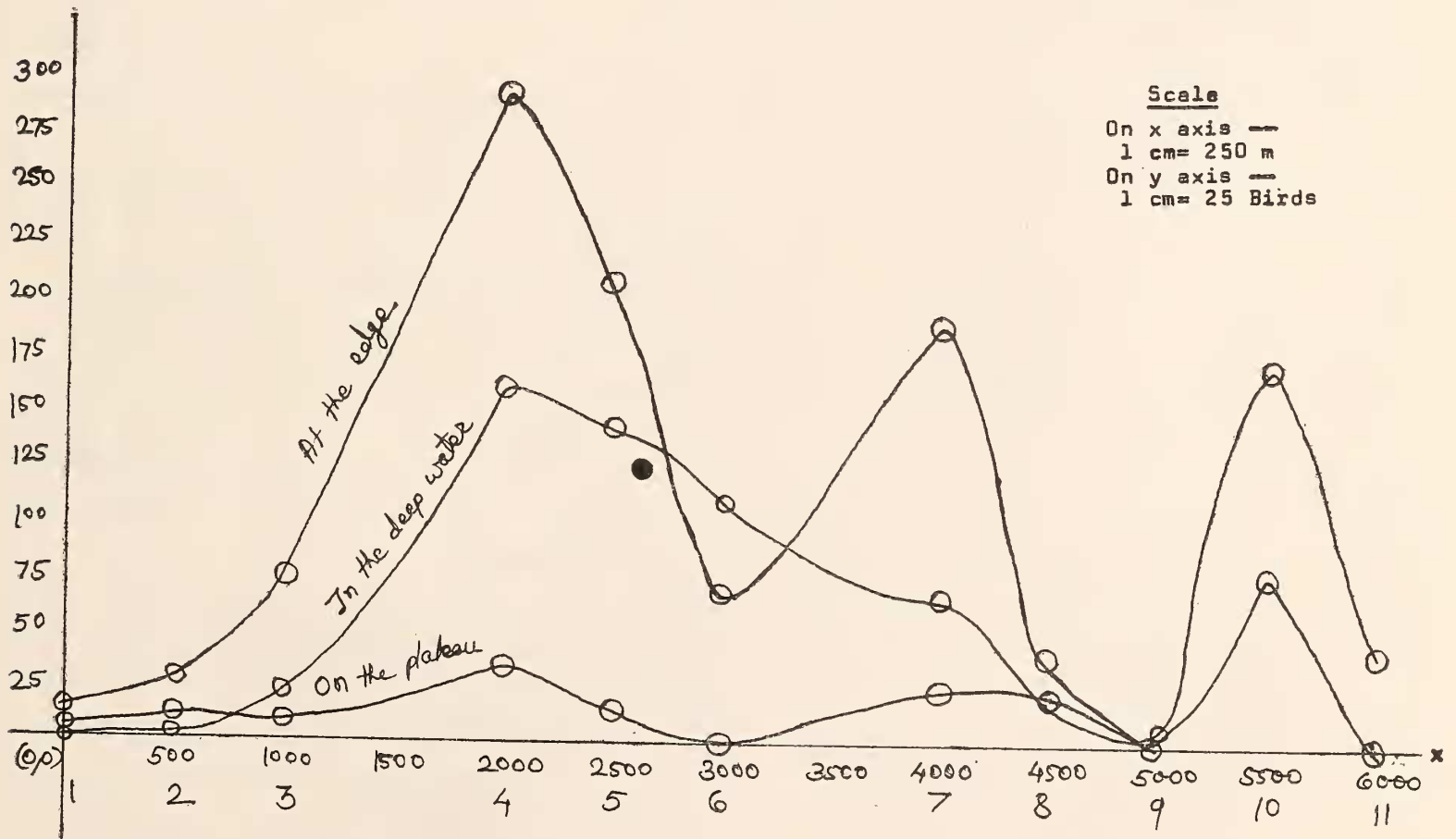


Fig. 2. Distribution of Birds along the river according to Habitat.

TABLE 2

DISTRIBUTION OF BIRDS COMMONLY SEEN ALONG THE MULA-MUTHA, JANUARY-APRIL 1983

Bird Species	THE RIVER-COURSE BETWEEN:-	(1) Vitthalwadi to Garware College Causeway				(2) Garware College Causeway to the Sangam				(3) Bird Sanctuary			
		Jan	Feb	Mar	Apr	Jan	Feb	Mar	Apr	Jan	Feb	Mar	Apr
Little Cormorant		F	F	F	F	F	F	F	F	F	F	F	F
Little Egret		F	F	C	C	C	C	VC	VC	VC	VC	A	A
Median Egret		F	C	C	VC	VC	VC	VC	VC	VC	VC	VC	VC
Cattle Egret		—	—	F	F	C	C	C	C	VC	VC	C	C
Pond Heron		F	C	C	VC	F	C	C	C	VC	VC	VC	VC
Shoveller		—	—	—	—	—	—	—	—	F	F	F	F
Dabchik		F	F	C	C	C	F	C	VC	C	A	A	A
Pintail		—	—	—	—	—	—	—	—	A	A	—	—
Garganey Teal		—	—	—	—	—	—	—	—	VC	A	A	A
Coot		—	—	—	—	—	—	—	—	F	F	F	F
Redwattled Lapwing		F	F	F	F	F	F	F	F	F	F	F	F
Blackwinged Stilt		F	C	C	C	A	A	A	A	A	A	A	C
Gullbilled Tern		F	F	F	F	F	F	F	F	C	A	VC	C
Green Bee-eater		C	C	C	C	F	F	F	F	C	C	C	C
Pied Kingfisher		F	F	F	F	F	F	F	F	F	F	F	F
Small Blue Kingfisher		F	F	F	F	F	F	F	F	F	F	F	F
White-breasted Kingfisher		F	F	F	F	F	F	F	F	F	F	F	F
Yellow Wagtail		C	C	C	C	F	F	F	F	VC	VC	VC	VC

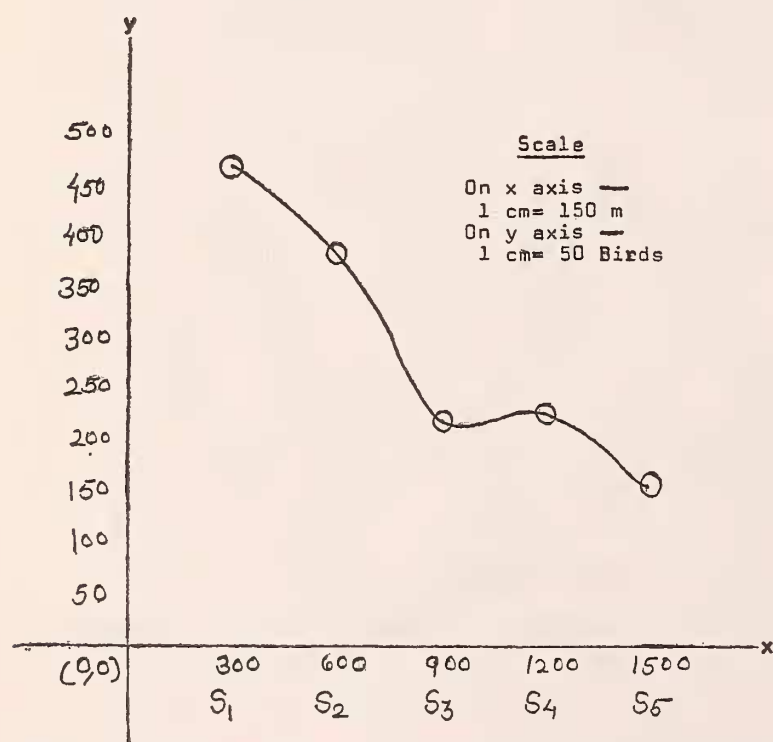


Fig. 3. Distribution of Birds in the Bird Sanctuary.

definite places where birds were seen to congregate. These three places according to the number of birds found there, are: 1. The stretch between the Pumping Station and Datta-wadi Bridge, 2. The stretch between this bridge and Garware College causeway, 3. The stretch between the broken causeway behind PMT bus terminus and Omkareshwar temple. Fig. 3 shows the distribution of birds in the Bird Sanctuary.

Fig. 2 shows birds at different places along the river Mutha according to three broad habitat types. As will be seen from the figure, the number of birds seen along the edges of the river was the highest followed by the number seen in deepish water. The number of species seen along the edges was 15 while those

BIRDS OF A POLLUTED RIVER

TABLE 3
DISTRIBUTION OF MORE NUMEROUS BIRDS ALONG THE MULA-MUTHA, JANUARY 1983.

River-course between:- (1)											
	Vitthalwadi			Pumping Station			Dattawadi Br.			Garware Causeway	
	Ja	Fe	Ap	Ja	Fe	Ma	Ap	Ja	Fe	Ma	Ap
Egrets	C	F	F	F	C	C	VC	C	C	VC	VC
Pond Herons	F	F	F	F	C	C	VC	F	C	C	C
Dabchik	F	F	—	F	F	C	C	C	VC	VC	C
Blackwinged Stilt	F	F	F	F	C	C	C	A	A	A	A
Gull-billed Tern	F	F	F	F	F	F	F	F	F	F	F

River-course around:- (2)											
	Sambhaji Br.			Omkareshwar			Shivaji Br.				
	Ja	Fe	Ap	Ja	Fe	Ma	Ap	Ja	Fe	Ma	Ap
Egrets	VC	C	VC	C	C	C	C	F	F	F	F
Pond Herons	C	C	C	C	C	C	C	F	F	F	F
Dabchik	F	F	—	C	C	C	C	F	F	F	F
Blackwinged Stilt	VC	A	VC	C	A	C	C	F	F	—	—
Gull-billed Tern	F	—	—	F	F	—	—	F	F	F	—

River-course around:- (3)											
	Dengle Br.			Sangam Br.			Bird Sanctuary				
	Ja	Fe	Ap	Ja	Fe	Ma	Ap	Ja	Fe	Ma	Ap
Bird-Species	C	C	C	C	VC	VC	C	A	A	A	A
Pond Herons	C	C	C	C	C	C	C	VC	VC	VC	VC
Dabchik	C	C	VC	VC	VC	C	C	A	A	A	C
Blackwinged Stilt	F	F	F	F	F	F	F	C	A	A	A
Gull-billed Tern	C	C	F	C	C	F	F	C	A	VC	C

Explanation : Table Nos. 2 and 3. A Bird no.s between 71 and above i.e. Abundant

F Bird no.s between 1 and 10, i.e. Few
 C Bird no.s between 11 and 30 i.e. Common
 VC Bird no.s between 31 and 70 i.e. Very Common
 Ja January
 Fe February
 Ma March
 Ap April

seen in deepish water was 7. Some of the species like Blackwinged Stilt were common to both these habitats. In the Bird Sanctuary (Fig. 4) the number of species seen along the

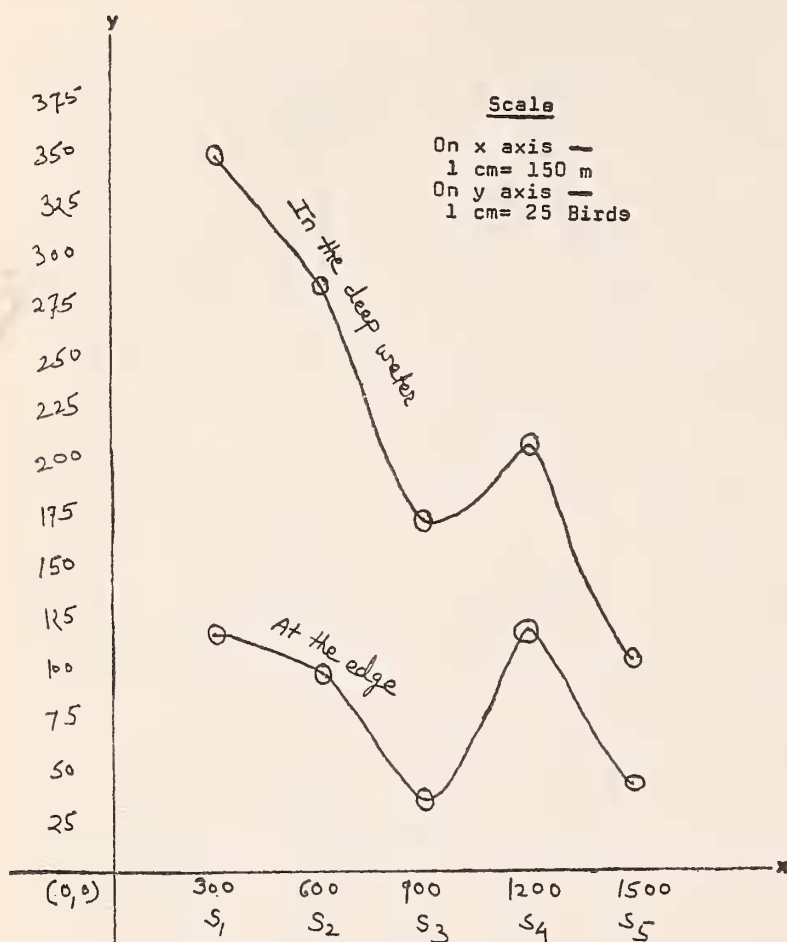


Fig. 4. Distribution of Birds in the Bird Sanctuary according to Habitat.

edges was 17 while in deepish water the number was 12. While counting these numbers such species as House and Jungle Crow, Common Myna, Pariah Kite and Little Brown Dove which are not strictly river-birds are excluded. In the bird count taken in March 1979, in the Bird Sanctuary, 39 species had been recorded with a total number of about 1200 individuals (P. Gole 1980).

The quality of water where birds were seen to concentrate, was also examined. As has been pointed out in the section on water-quality, the river takes on an increasing load of organic pollution as it flows from Vitthalwadi on-

wards. It will now be interesting to see if any change in the composition of bird species in different months on the stretches where birds concentrated, can be detected. Table No. 2 gives this information. The table shows that in the first two stretches the numbers of egrets, stilts, dabchiks, and Gullbilled terns are low; while these birds become more numerous from Garware College causeway to Omkareshwar temple. We have recorded in greater detail the distribution of these species between January and April. Table No. 3 shows their distribution along the entire river course. From this it is clear that these birds are fewer where the quality of water is better and drains do not overflow into the river. Their numbers progressively increase as the quality of water deteriorates and its organic content goes up. It appears that these birds have adopted the role of scavengers along the river course. Special mention should be made of Blackwinged Stilt. These were found to be concentrated, at places in very large numbers, where streams loaded with faecal matter and drains flow into the river. To a lesser extent this can be said to be true of the three species of egrets also. Gullbilled terns were also seen to patronize such places in numbers and to swoop repeatedly to pick up floating organisms.

As the summer advances and April gives way to May, most of the migratory birds including the hordes of Blackwinged Stilt which make the dirty river so colourful, will have left. June and July would see even the egrets disappearing from the river. With the monsoon in full swing, floods roar down the river channel and the turbulent stream appears to cleanse itself of all the dirt that man continues to heap on it.

ACKNOWLEDGEMENTS

The study formed a part of the much wider

BIRDS OF A POLLUTED RIVER

investigation aimed at drafting an eco-development plan for the improvement of Pune's river-fronts. This wider study was financed by the Ecological Society of Pune. I was helped in the field by Miss S. Limaye, Miss S. Ranjekar and Miss S. Jangam. The water-samples

were analysed by Shri Kirad of Kirloskar Consultants Ltd. and Dr. Godbole of Vidnyanvardhini. Botanical specimens were identified by Dr Vartak of Vidnyan-wardhini and Miss Sane of Garware College. I thank all these persons.

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